

GENERAL COMMENTS

I think there is a sufficient amount of new results in this paper to warrant publication, after the authors significantly strengthen the arguments, address some possible data interpretation errors, and clean up the figures, as detailed below. Also, Section 4, on the integrated effect of ENSO events on stratospheric temperature and water vapor, is particularly weak. First of all, it is unclear to me why you would want to examine the integrated effect of ENSO events, rather than just the separate effects of El Niño and La Niña events. You need to give the rationale. In addition, according to your discussion on p. 4152, El Niño and La Niña events influence stratospheric water vapor through different mechanisms. So isn't it inappropriate to combine them in an analysis of the integrated effect? Furthermore, the paragraph on long-term trends contains only a cursory mention of analysis results without presenting any numerical or graphical results. I recommend that Section 4 be significantly revised or possibly omitted. The paragraph on long-term trends could perhaps be moved to the "Summary and conclusions" section to serve as a discussion of possible future work.

Although you do a good job of citing relevant literature in the Introduction, I think the paper needs more background to help the reader understand why the analysis reported here is relevant. For example, you might want to briefly summarize the observed frequency and magnitude of El Niño and La Niña events in the past and projected future variability, and explain that your analysis contributes potentially to better understanding of why stratospheric water vapor has varied in the past and how it might vary in the future.

SPECIFIC COMMENTS

p. 4144, lines 18-22: You describe the NCEP reanalysis-2 data set here, but you don't actually show any results based on that data set, except for a brief mention at the end of Section 4. You should revise the text here.

p. 4145-4146: You discuss to a certain extent the caveats of using reanalysis data to study stratospheric water vapor, and explain that you use MLS and HALOE data to cross-check the robustness of the reanalysis-based results. However, I'm not fully convinced that the robustness of the results for the earlier decades can be confidently inferred based on the satellite data, which only start in 1993 and have large uncertainties. I think you need to provide a more extensive assessment of the robustness or validity.

p. 4146, lines 5-6 and 23-26: The coarse vertical resolution of the reanalysis model around the tropopause doesn't allow for precise investigation of temperature effects on troposphere-to-stratosphere transport of water vapor. I think you should include some discussion of the uncertainties associated with this coarse resolution.

p. 4148, lines 23-27: You state that "The vertical velocity fields during ENSO events (Fig. 3f) show a strong upward motion around the middle and eastern Pacific, and a relatively weak upward motion over the western Pacific and Indian Ocean in ENSO situations suggesting that

vertical transport of water vapor is stronger over the middle and eastern Pacific than that over the western Pacific and Indian Ocean during ENSO events.” But Fig. 3f seems to me to show the opposite: The vertical velocities are quite weak in the middle and eastern Pacific (in some locations even slightly negative) while they are much stronger over the western Pacific and Indian Ocean. If I’m correct, you’ll need to revise the discussion in the rest of the paragraph as well, proposing a new explanation for the water vapor anomalies that extend well above the 390 K isentropic surface over the middle and eastern Pacific.

Also, do the regional differences in vertical transport also exist during non-ENSO periods? Since you don’t mention the non-ENSO periods, one (including myself) might wonder why the differences are only limited to El Nino and La Nina periods and not the neutral ones.

p. 4149: You use the 2005-2010 MLS water vapor record to help assess ENSO effects; were there any complete La Nina events during that period? Perhaps only one? You should report how many La Nina (and El Nino) events occurred during the period and note that the small number of events may not be representative of a longer-term climatology.

p. 4150, lines 18-21: You state that the HALOE data do not exhibit moistening in the lower stratosphere between 5S-5N during El Nino events. However, the data actually exhibit slight moistening between 100 and 80 hPa. The region below 100 hPa is generally not stratospheric so you should exclude it from the discussion.

p. 4152, lines 19-27: You should explain how enhanced upwelling can overcome the limit on water vapor mixing ratio placed by cold tropopause temperatures and lead to higher stratospheric mixing ratios. The answer is not obvious.

p.4153-4154: Why do you discuss temperature anomalies in the middle stratosphere? Only tropopause temperatures are relevant for stratospheric water vapor anomalies.

TECHNICAL CORRECTIONS

p. 4144, lines 17-21: References for these two reanalysis data sets would be helpful.

p. 4145, line 1: This is the first mention of the acronym “ONI” other than in the Abstract, so you should define it (spell it out) here.

p. 4145 and p. 4152: You refer to “normal” ENSO conditions. I believe the term “neutral” is more standard terminology.

Figure 1: The text above the four plots is nearly illegible. The font size for the text next to the color bars could be increased too. Please make similar changes for the other figures as well.

Figure 4: The caption incorrectly reverses the definitions of the dashed and dotted lines—dashed should correspond to the Southern Hemisphere, etc.

Figure 5:

--The bottom axes in these plots seem incorrect: isn’t 0 degree longitude supposed to lie at the left edge of the plots rather than at the center?

--5a and b are difficult to compare with Fig. 2b and d since the former represent different values using colors while the latter use contour lines. I suggest making them consistent.

--5c and d cannot be exactly compared with Fig. 3a-b and 3c-d since the former show the average over 25N-25S while the latter cover the ranges 25-2.5N and 2.5-25S, skipping the region between 2.5N and 2.5S. Furthermore, the two sets of plots cover slightly different altitude ranges, i.e. 370-450 K vs. 360-440 K. Please try to make them consistent.

--5e and f display different units on the vertical axis (pressure hPa) from 4a and b (potential temperature K).

p. 4152 (and throughout the paper): The frequent use of the "/" symbol, in phrases like "El Nino/La Nina" and "weaken/enhance", makes the text difficult to read. It would be helpful to replace this wording, at least some of the time, with sentences in which you discuss the two items separately.

p. 4154, line 10: The word "recorder" should be changed to "records".

p. 4154, line 12: I think "ineligible" should be changed to something similar to "important".